行政院國家科學委員會補助專題研究計畫成果報告

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※　軍事支出對經濟成長與實質利率影響效果之分析　※
※　**Military Expenditure, Economic Growth and Real Interest Rates**　※
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計畫類別：■個別型計畫　　□整合型計畫
計畫編號：**NSC－90－2415－H－034－010**
執行期間：**2001** 年 **08** 月 **01** 日至 **2002** 年 **07** 月 **31** 日

計畫主持人：**謝智源**
共同主持人：
計畫參與人員：**廖嘉立、廖祥亨**

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執行單位：**中國文化大學經濟學系**

中　華　民　國　**91**　年　**10**　月　**10**　日

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Preparation of NSC Project Reports

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主持人：**謝智源**　中國文化大學經濟學系

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一、中文摘要

本計劃利用一個納入國防特質的內生成長模型來討論政府暫時性的國防支出增加對於長短期經濟成長率與實質利率的影響。分析的結果指出：軍事支出增加會刺激經濟成長而且會提高長期利率。

關鍵詞：經濟成長、實質利率、軍事支出

Abstract

This paper develops an endogenous growth model with endogenous leisure-labor choice to examine how the military expenditure will govern economic growth and real interest rates. It is found that an increase in military spending will stimulate the growth rate and raise real interest rates in the long run.

Keywords: Economic growth, defense spending, real interest rates

二、緣由與目的

This paper formulates a simple endogenous growth model with endogenous leisure-labor choice to study how the military spending and income tax will govern economic growth and real interest rates. In his often-cited paper, Benoit (1973)(1978) uses 44 less developed countries during the 1950-1965 period concludes that defense spending will stimulate economic growth, is often called the *Benoit hypothesis*. But the subsequent researches show an inconsistent conclusion on this subject. For example, Macnair et al.(1995), Brumm (1997) and Murdoch et al.'s (1997) findings support Benoit hypothesis; Biswas and Ram (1986) and Huang and Mintz (1990)(1991) conclude no significant effect of defense spending on economic growth; on the other hand, Deger and Smith (1983), Faini et al. (1984) and Deger (1986) show a negative of defense spending on growth.

On the other hands, the interaction between government expenditures and the real interest rates is another controversial subject in the theoretical prediction and empirical observation. Barro (1984), Blanchard and Fischer (1989) and Romer (1996) indicate that permanent increases in government spending do not affect real interest rates while temporary increases in government spending raises real interest rates. However, empirical evidence shows an inconsistent conclusion on this subject. As Barro (1984) (1989) claims, the U. S. data do not confirm a positive effect of wartime spending on real interest rates. Specifically, real interest rates appears lower during wars. But the U. K. data are consistent with the prediction of theory.

三、The Model

Consider an economy consisting of a representative household and a government. The household produces a single composite commodity which can be consumed, accumulated as capital, and paid for tax. The government provides defense security by means of spending on arms accumulation.

The representative household derives positive utility from consumption, c, and the home weapon stock, M, and derives negative utility from labor, λ. With this understanding, the household chooses consumption and leisure so as to maximize the discounted sum of utility subject to budget constraint equation, and given the

initial capital. The maximization problem of the representative household can be expressed as:

$$\int_0^{\infty} (\ln c + \eta \ln M - \theta \ln \lambda) e^{-\rho t} dt, \qquad (1)$$

$$\text{s.t. } \dot{k} = (1-\tau) k^{\alpha} M^{1-\alpha} \lambda^{\varepsilon} - c - T, \quad (2)$$

where an overdot denotes the rate of change with respect to time, ρ is the subjective time preference rate, τ is the income tax rate, T is a lump-sum tax, and the parameters η and θ measure the impact of home weapon stock and labor on the welfare of the household, respectively. The restriction $0 < \varepsilon < 1$ is imposed to ensure positive but diminishing marginal productivity of labor. Using equation (1) and (2), the optimal condition in consumption is given by:

$$c = \frac{(1-\tau)\varepsilon}{\theta} Q. \qquad (3)$$

$$\frac{\dot{Q}}{Q} = \frac{\dot{c}}{c} = \alpha(1-\tau)\frac{Q}{k} - \rho, \qquad (4)$$

where $0 < (1-\tau)\varepsilon/\theta < 1$ is marginal propensity of consumption.

The government is assumed to collect its income tax revenue and lump-sum tax revenue to finance the armament procurement. In order to sustain an equilibrium with balanced growth, following Turnovsky (1995) and Bruce and Trunovsky (1999), assume that the government sets its weapon procurement expenditure, g, as a fixed fraction of output, that is:

$$g = \beta Q = \beta k^{\alpha} M^{1-\alpha} \lambda^{\varepsilon}; \quad 0 < \beta < 1. \quad (5)$$

The parameter β usually is interpreted as an index of the defense burden. In addition, the government budget constraint is given by:

$$\tau k^{\alpha} M^{1-\alpha} \lambda^{\varepsilon} + T = g = \beta k^{\alpha} M^{1-\alpha} \lambda^{\varepsilon}. \quad (6)$$

Assuming, for simplicity, that home weapon does not depreciate, the stock of home weapon accumulation process can be described by:

$$\dot{M} = \beta k^{\alpha} M^{1-\alpha} \lambda^{\varepsilon}. \qquad (7)$$

Plugging equations (3) and (6) into (2), the resource constraint for the whole economy is given by:

$$\dot{k} = [1 - \beta - \varepsilon/\theta] Q. \qquad (2a)$$

Along a balanced growth path, private consumption, private capital stock, public capital stock and home weapon stock will grow at the same rate. Let γ^* be the steady-state growth rate, and note that $\dot{Q}/Q = \dot{c}/c = \dot{k}/k = \dot{M}/M = \gamma^*$ is held in the steady-growth equilibrium. It is quite easy to infer from equations (4) and (2a) that:

$$\gamma^* = \frac{[(1-\beta)\theta - (1-\tau)\varepsilon]\rho}{\omega}, \qquad (8)$$

where $\omega = \alpha\theta(1-\tau) - (1-\beta)\theta + (1-\tau)\varepsilon$. We confine our analysis to the situation where the economy exhibits a positive sustained growth and the agent's utility is bounded, so in what follows the restrictions $\omega > 0$ and $(1-\beta)\theta - (1-\tau)\varepsilon > 0$ are imposed.

Using equation (8), we have following comparative statics:

$$\frac{\partial \gamma^*}{\partial \beta} = \frac{-\alpha\theta^2(1-\tau)\rho}{\omega^2} < 0,$$

$$\frac{\partial \gamma^*}{\partial \tau} = \frac{\alpha\theta^2(1-\beta)\rho}{\omega^2} > 0.$$

Obviously, a permanent rise in the defense burden will lower the steady-state growth rate, while a permanent rise in income tax rate will stimulate the steady-state growth rate. Intuitively speaking, a rise in defense spending will lower the marginal propensity of saving, and a rise in income tax rate will increase the marginal propensity of saving. Hence, a permanent rise in the defense spending will decrease economic growth and a permanent rise in the income tax rate will increase steady-state growth rate.

四、Military Expenditure and Real Interest Rates

In this section we turn to examine how the transitional adjustment of real interest rates will exhibit following an unanticipated temporary increase in military expenditures.

Following Futagami et al. (1993), Barro and Sala-i-Martin (1995) and Faig (1995), we define $x = Q/k$. From equations (2a) and (4), the dynamic system in terms of the transformed variable is given by:

$$\frac{\dot{x}}{x} = \omega\theta x - \rho. \qquad (9)$$

Define $z = (Q/k)^{-1}$ and use equation (9), the dynamics of the economy can be expressed by the transformed variables z:

$$\dot{z} = \rho z - \omega .$$

Obviously, the characteristic root of the system is positive. The general solution for z thus can be described as:

$$z = z^* + Be^{\rho t} . \qquad (10)$$

where $z^* = \omega/\rho$ is the steady-state value of z and B is an undetermined coefficient.

We first trace the evolution of the economy following an unanticipated temporary rise in military expenditures. Assume that initially the economy is in a steady state with $\beta = \beta_0$. The experiment we conduct is that, at $t = 0$, the authority increases its defense burden from β_0 to β_1 and at the same time announces that defense burden will return to its original level β_0 at a specific date $t = T$.[1] Base on the general solution of z reported in equation (10), we can use the following equation to express the feature of such a policy switch:

$$z_t = \begin{cases} z^*(\beta_0); & t = 0^- \\ z^*(\beta_1) + Be^{\rho t}; & 0^+ \le t \le T^- \\ z^*(\beta_0); & T^+ \le t \end{cases} \qquad (11)$$

where 0^- and 0^+ denote the instant before and after a rise in defense spending, respectively; T^- and T^+ denote the instant before and after the reversion of military expenditures, respectively. There are some supplementary explanations for the specifications of equation (11). First, at time 0^-, the economy is in its stationary equilibrium with $\beta = \beta_0$; the stationary value of z thus are associated with β_0. Second, during the dates between 0^- and T^-, the military expenditure has increased, and the steady-state value of z thus are correspond to β_1; while T^+ onward, the defense burden will return from β_1 to β_0, and the steady-state value of z corresponds to β_0. Third, as the defense burden will return from β_1 to β_0 at the moment of time T^+, the stability of the system requires the economy to move exactly to the steady-state equilibrium associated with β_0 at that instant of time. This means the undetermined coefficient associated with unstable eigenvalue, namely B^*, must be set to zero from T^+ onwards.

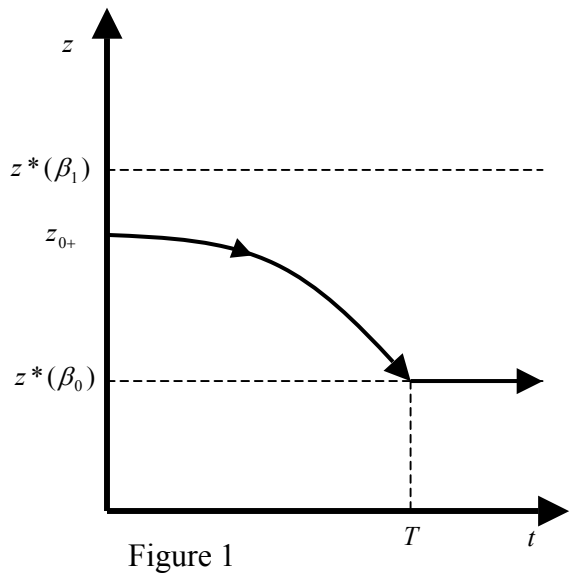

Figure 1

To understand the exact path of z, we must solve an appropriate value for B. The continuity condition of the forward-looking model requires $z_{T^-} = z_{T^+}$. Substituting equation (11) into this continuity condition yields:

$$z^*(\beta_1) + Be^{\rho T} = z^*(\beta_0) .$$

It gives:

$$B = [z^*(\beta_0) - z^*(\beta_1)]e^{-\rho T} < 0 . \qquad (12)$$

Substituting the value of B in equation (12) into (11), we have the complete solution for z. Furthermore, it is obvious from equation (11) that, at the instant of the policy expansion, the instantaneous jump of z is $z_{0^+} - z_{0^-} = [z^*(\beta_1) - z^*(\beta_0)](1 - e^{-\rho T}) > 0$. Figure 1 illustrates the transitional behavior of z in response to an unanticipated temporary shock in defense burden. As indicated in Figure 1, at the instant 0^+, z will immediately rise from $z^*(\beta_0)$ to z_{0^+}. Subsequently, from 0^+ to T^-, as the arrows indicate, z continues to fall. At

[1] It should be noted that the special situation where $T \to \infty$ implies an permanent shock.

time T^+, when defense burden reverses to its original level β_0, z exactly reaches the steady-state equilibrium $z^*(\beta_0)$.

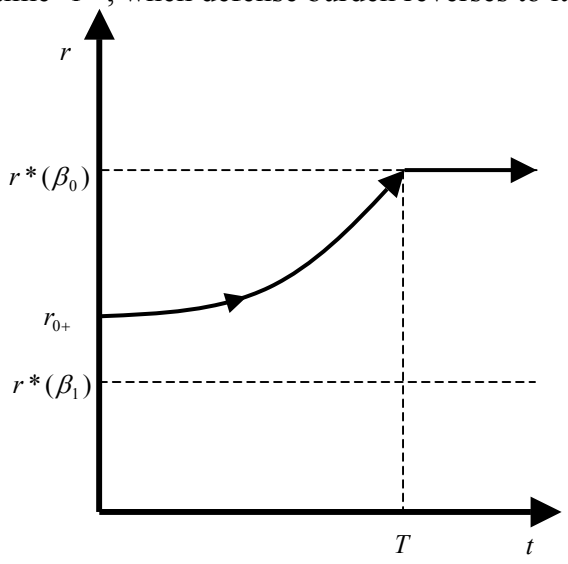

Figure 2

Given that the real interest rate, r, is the marginal physical product of capital, we have:

$$r = \partial Q / \partial k = \alpha(Q/k) = \alpha z^{-1}. \qquad (13)$$

Accordingly, we can infer the transitional behavior of r from observing the dynamic adjustment of z. The time path of r is presented in Figure 2. At the instant 0^+, z rises on impact from $z^*(\beta_0)$ to z_{0^+}, implying that r falls on impact from $r^*(\beta_0)$ to r_{0^+}. Subsequently, z continues to fall from date 0^+ to T^-, and accordingly r rises monotonically over time.[2] From T^+ onward, defense burden reverses to its original level β_0, both z and r stay put at their stationary levels $z^*(\beta_0)$ and $r^*(\beta_0)$.[3] It is clear in Figure 2 that the real interest rate is *lower* than its initial level $r^*(\beta_0)$ during the period that the government actually boosts defense expenditures. This result can be viewed as a plausible vehicle to solve the puzzle why the real interest rate appears lower during wars.

[2] Differentiating equation (13) with respect to time gives $\dot{r} = -\alpha z^{-2}\dot{z}$.

[3] The long-run relationship between the real interest rate and defense burden is $\partial r^*/\partial\beta = -\alpha/\rho(z^*)^2 < 0$.

五、Concluding Remarks

This paper develops an endogenous growth model with endogenous leisure-labor choice to examine the macroeconomic effect of military spending on economic growth and real interest rates. Based on the framework, two main conclusions are drawn. First, a permanent rise in defense spending will depress the balanced growth rate, this result runs sharp contrast to the Beonit (1973, 1978) empirical findings. Second, a rises in defense burden will lower the real interest rate in the long run, the real interest rate rises over time during the high military expenditure period, but is lower than the long-run interest rate.

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